Liquid Argon Detector Test Beam

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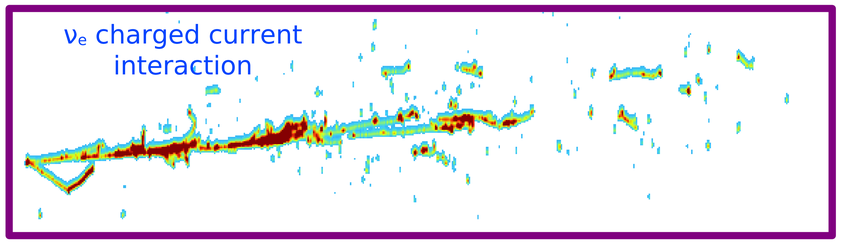
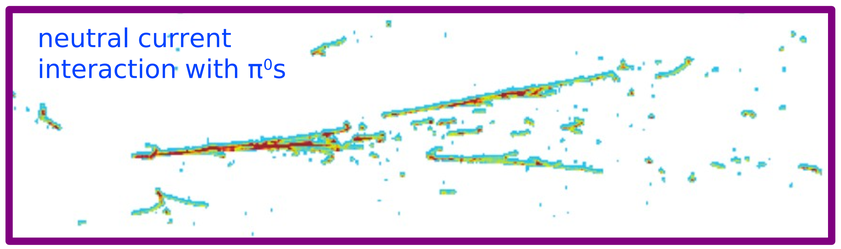
Motivation

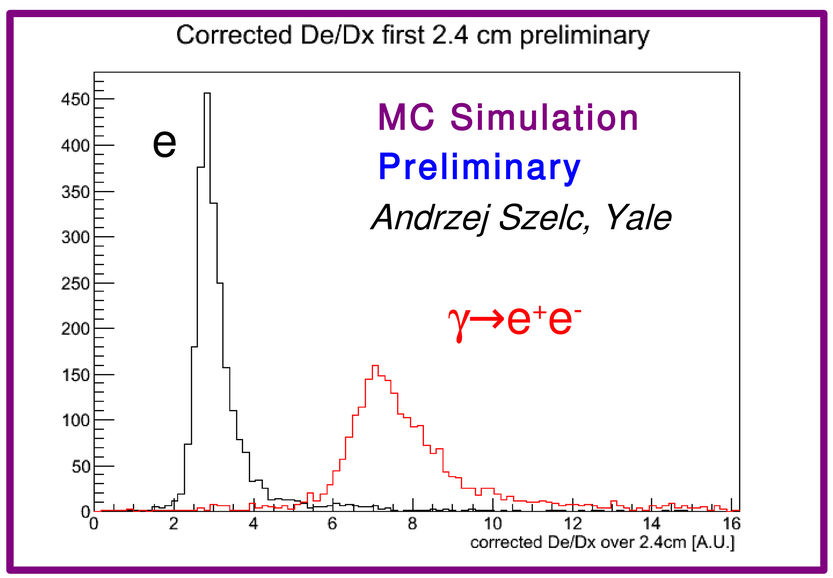
- Neutrino mass hierarchy and CP violation!
- Must measure $\nu_\mu \rightarrow \nu_e$ over a long baseline
- Next generation detector technology: LArTPC
- Milli-meter scale position resolution
- Efficient identification of ν_e interactions



- Rejection of neutral current background

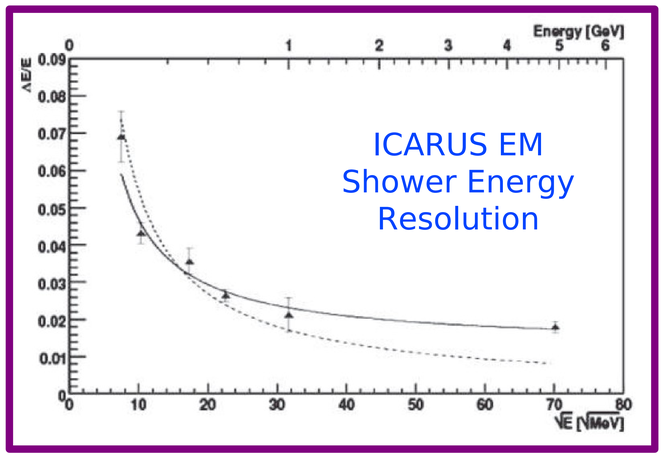


- electron vs. photon discrimination via dE/dx



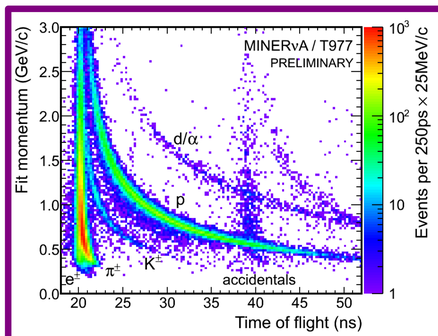
Energy Scale & Resolution

- Oscillations depend on energy as L/E
- Unbiased energy reconstruction critical for correctly inferring oscillation parameters
- Energy resolution smears out oscillations peaks and dips → must be well understood



- Very little data: cosmic ray induced π^0 in ICARUS + T32 800MeV @ JPARC

Fermilab Test Beam Facility



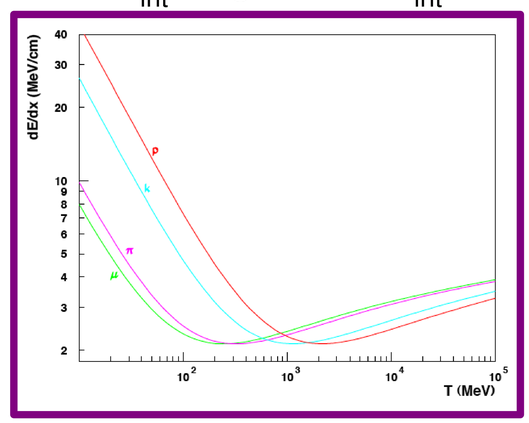
- Long term facility for calibration and R&D
- Serves the needs of all future LArTPC expts.
- Tertiary beamline constructed for MINERvA
- M7 area available for long term studies
- Permanent cryogenic facilities
- Space for "few-meter" sized setups

Phase I: Modified Argoneut

- Add PMTs to detect scintillation light
- Cold electronics
- New liquid filtration system
- Beam window
- Study:
  (1) charge to energy calibration
  (2) electron-ion recombination
  (3) initial ionization in EM showers → e vs. γ

Phase II: A Large TPC

- Measure energy scale and energy resolution
- LAr: X_0=14cm, λ_{int}=80cm
- Need a detector 3-4 λ_{int} long and ~2 λ_{int} wide to offer good containment
- Identification of π,K,p via dE/dx + interaction/ decay signatures
- MC tuning & event reconstruction development



- FNAL provides beam & cryo. system based on MicroBooNE, users provide detectors
- Possible R&D topics: light collection, e^- diffusion, high rate operation (cosmics, event pileup), dual phase readout, etc.